RFX8055 CMOS Single-Chip/Single-Die 5GHz RFeIC with PA, LNA & SPDT for 802.11ac/n/a

MP Evaluation Board Test Results Summary & Technical Notes
RFX8055 5GHz WiFi RFeIC with PA, LNA, & SPDT

**Functional Block Diagram**

**Product Overview**
- Single-Chip, Single-Die RF Front-End IC
- PA + LNA + SPDT Switch + Harmonic Filters
- 802.11 a/n/ac WLAN
- Bulk CMOS
- 5.1 – 5.95 GHz Operation
- Very Low DC Power Consumption

**Key Features**
- High Transmit Linearity meeting 802.11ac WiFi Standard
- Integrated Power Detector for Transmit Power Monitor and Control
- 27dB TX Gain
- 13 dB LNA Gain or LNA Bypass mode
- Complete On-Chip RF Decoupling and DC Block Capacitors – No External Inductors
- 2.3 mm x 2.3 mm x 0.4 mm, 16L QFN Package

**RFX8055 Applications**
- Smartphones, Feature Phones
- Laptops / Netbooks / Smartbooks
- Tablets/ MIDs
- Access Points/ Gateways
- 802.11ac/n/a Portable Platforms

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**6/2/2015**
# RFX8055 Pin-out and Pin Description

![Diagram](image)

<table>
<thead>
<tr>
<th>Pin Number</th>
<th>Pin Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1, 3, 7, 12, 14, 17</td>
<td>GND</td>
<td>Ground – Must Be Connected to GND in the Application Circuit</td>
</tr>
<tr>
<td>2</td>
<td>RX</td>
<td>RF Output Port from LNA or Bypass – DC Shorted to GND</td>
</tr>
<tr>
<td>4</td>
<td>VDD</td>
<td>DC Supply Voltage</td>
</tr>
<tr>
<td>5</td>
<td>DET</td>
<td>Analog Voltage Proportional to the PA Power Output</td>
</tr>
<tr>
<td>6</td>
<td>PA_EN</td>
<td>CMOS Input to Control TX Enable</td>
</tr>
<tr>
<td>8</td>
<td>TX</td>
<td>RF Input Port from the Transceiver – DC Shorted to GND</td>
</tr>
<tr>
<td>9</td>
<td>VMODE</td>
<td>CMOS Input to Control High-Linearity/Low-Current Mode</td>
</tr>
<tr>
<td>13</td>
<td>ANT</td>
<td>Antenna Port (RF Signal from the PA or RF Signal Applied to the LNA) – DC Shorted to GND</td>
</tr>
<tr>
<td>10, 11, 15</td>
<td>NC</td>
<td>Internally Not Connected</td>
</tr>
<tr>
<td>16</td>
<td>LNA_EN</td>
<td>CMOS Input to Control RX Enable</td>
</tr>
</tbody>
</table>
**RFX8055 Eval Board, DC Bias and Control Logic**

**Evaluation Board Information:**
- 4-Layer Stack, 10mil/40mil/10mil
- FR4 with \( \varepsilon_r=4.5 \), \( \tan \delta = 0.02 \) (Typ)
- Results presented here are referenced to device pins with the trace loss de-embedded
- VDD should be on before applying ctrl signals
- VDD Nominal 3.3 Vdc. Operation from 3.0 to 3.6Vdc. Data presented at room temperature.

**EVB BOM**

<table>
<thead>
<tr>
<th>Designator</th>
<th>Value</th>
<th>Footprint</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>C3</td>
<td>1.0 uF</td>
<td>0402</td>
<td>X5R/X7R</td>
</tr>
<tr>
<td>C6</td>
<td>220 pF</td>
<td>0402</td>
<td>X5R/X7R</td>
</tr>
<tr>
<td>C7</td>
<td>0.2 pF</td>
<td>0201</td>
<td></td>
</tr>
<tr>
<td>C8</td>
<td>22uF</td>
<td>Case A</td>
<td>Tantalum</td>
</tr>
<tr>
<td>R1, R2, R3</td>
<td>1KΩ</td>
<td>0402</td>
<td></td>
</tr>
<tr>
<td>R4</td>
<td>10KΩ</td>
<td>0402</td>
<td>Detector Load</td>
</tr>
</tbody>
</table>

* Only needed if control lines exceed 1.8 V

**Control Logic Truth Table**

<table>
<thead>
<tr>
<th>PA_EN</th>
<th>LNA_EN</th>
<th>VMODE</th>
<th>Mode Of Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>X</td>
<td>Shutdown/LNA Bypass Mode</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>High Linearity Transmit Mode</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>X</td>
<td>Receive Mode, LNA On</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
<td>Low Current Transmit Mode</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>X</td>
<td>Low Current Transmit Mode</td>
</tr>
<tr>
<td>All Others</td>
<td></td>
<td></td>
<td>Unsupported (No Damage)</td>
</tr>
</tbody>
</table>

Note: “1” denotes high voltage state (> 1.2V) at Control Pins
“0” denotes low voltage state (< 0.4V) at Control Pins
“X” denotes the don’t care state
1KΩ – 10KΩ series resistor may be required for each control line
RFX8055 Measured Currents for Modes of Operations
(No RF Signal Applied)

<table>
<thead>
<tr>
<th>PA_EN</th>
<th>LNA_EN</th>
<th>VMODE</th>
<th>Mode Of Operation</th>
<th>Measured Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>X</td>
<td>Shutdown/LNA Bypass Mode</td>
<td>3.0 uA</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
<td>High Linearity Transmit Mode</td>
<td>152 mA</td>
</tr>
<tr>
<td>0</td>
<td>1</td>
<td>X</td>
<td>Receive Mode, LNA On</td>
<td>13 mA</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
<td>1</td>
<td>PA Power Save Mode</td>
<td>110 mA</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>X</td>
<td>PA Power Save Mode</td>
<td>110 mA</td>
</tr>
</tbody>
</table>
EVB Signal Loss De-Embedding

<table>
<thead>
<tr>
<th>RF Signal</th>
<th>Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANT</td>
<td>.42 dB</td>
</tr>
<tr>
<td>TX</td>
<td>.42 dB</td>
</tr>
<tr>
<td>RX</td>
<td>.42 dB</td>
</tr>
</tbody>
</table>

Total EVB Loss Includes the Trace and Connector

Signal Source EVM is less that -45 dB and is not de-embedded
RFX8055 Recommended Application Schematic

Schematic BOM

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</tr>
<tr>
<td>C7</td>
<td>0.2 pF</td>
<td>0201</td>
<td></td>
</tr>
<tr>
<td>R1, R2, R3</td>
<td>1KΩ</td>
<td>0402</td>
<td>Not Required if control voltage &lt;1.8V</td>
</tr>
<tr>
<td>R5</td>
<td>10KΩ</td>
<td>0402</td>
<td>Detector Load</td>
</tr>
</tbody>
</table>
RFX8055 802.11ac Dynamic EVM MCS9 VHT80 vs. Output Power, VDD = 3.3V, over Frequency, 100 us Pulse, 50% Duty Cycle, 400nsec delay, High Linearity Transmit Mode

EVM (dB) VDD = 3.3V
RFX8055 802.11ac Dynamic EVM MCS9 VHT80 vs. Output Power, VDD = 3.3V, over Frequency, 4 ms Pulse, 50% Duty Cycle, 400nsec delay, High Linearity Transmit Mode

EVM (dB) VDD = 3.3V
RFX8055 802.11n Dynamic EVM MCS7 HT40 vs. Output Power, VDD = 3.3V, over Frequency, 100 us Pulse, 50% Duty Cycle, 400nsec delay, High Linearity Transmit Mode

**DEVN (dB) VDD = 3.3V**

![Graph showing EVM (dB) vs. Pout Burst (dBm) for different frequencies (5.19 GHz to 5.975 GHz).]
RFX8055 802.11n Dynamic EVM MCS7 HT20 vs. Output Power, VDD = 3.3V, over Frequency, 100 us Pulse, 50% Duty Cycle, 400nsec delay, High Linearity Transmit Mode

![Graph showing DEVM (dB) VDD = 3.3V for different frequencies ranging from 5.18 GHz to 5.825 GHz. The graph plots EVM [dB] against Pout Burst [dBm].](image-url)
RFX8055 802.11g Dynamic EVM 64 QAM vs. Output Power, VDD = 3.3V, over Frequency, 100 us Pulse, 50% Duty Cycle, 400nsec delay, High Linearity Transmit Mode

DEVM (dB) VDD = 3.3V
RFX8055 TX 802.11ac VHT40 MCS9 DC Current vs. Output Power
VDD = 3.3V over Frequency, High Linearity Transmit Mode

Max Burst Current, VDD = 3.3V

- 5.19 GHz
- 5.27 GHz
- 5.31 GHz
- 5.55 GHz
- 5.67 GHz
- 5.755 GHz
- 5.795 GHz

Current [mA] vs. Pout Burst [dBm]
RFX8055 802.11n Compliance Mask Margin HT40 MCS0 vs. Output Power, VDD = 3.3V, over Frequency, 100 us Pulse, 50% Duty Cycle, 400nsec delay, High Linearity Transmit Mode

Compliance Mask Margin, VDD = 3.3V
RFX8055 TX CW Gain and Detector Voltage vs. Output Power
VDD = 3.3V over Frequency, High Linearity Transmit Mode

Gain, VDD = 3.3V

VDET, VDD = 3.3V
RFX8055 CW Harmonics vs. Output Power
VDD=3.3V over Frequency, High Linearity Transmit Mode

2nd Harmonic, VDD = 3.3V

3rd Harmonic, VDD = 3.3V
RFX8055 RX Noise Figure and Gain vs. Frequency at VDD = 3.3V

Noise Figure vs. Frequency

Gain vs. Frequency

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RFX8055 TX Small-Signal S21, S11 at VDD = 3.3V, High Linearity Transmit Mode

PA_EN=High, LNA_EN= Low, VMODE= Low, Icq = 152 mA
RFAX8055 802.11ac Dynamic EVM MCS9 VHT80 vs. Output Power, VDD = 3.3V, over Frequency, 100 us Pulse, 50% Duty Cycle, 400nsec delay, Low Current Transmit Mode

DEVM (dB), VDD = 3.3V

EVM [dB]

Pout Burst [dBm]

-20
-22
-24
-26
-28
-30
-32
-34
-36
-38
-40
-42
-44
-46

5.21 GHz
5.29 GHz
5.53 GHz
5.61 GHz
5.69 GHz
5.775 GHz
-35dB line
RFX8055 TX 802.11ac VHT40 MCS9 DC Current vs. Output Power
VDD = 3.3V over Frequency , Low Current Transmit Mode

Max Burst Current , VDD = 3.3V
RFX8055 TX Small-Signal S21, S11 at VDD = 3.3V, Low Current Transmit Mode

PA_EN=High, LNA_EN= High, VMODE= Low, Icq = 110 mA
RFX8055 802.11ac Dynamic EVM MCS9 VHT80 vs. Output Power, VDD = 3.3V, over Frequency, 4 ms Pulse, 50% Duty Cycle, 400nsec delay, Low Current Transmit Mode

DEVM (dB), VDD = 3.3V
RFX8055 802.11n Dynamic EVM MCS7 HT40 vs. Output Power, VDD = 3.3V, over Frequency, 100 us Pulse, 50% Duty Cycle, 400nsec delay, Low Current Transmit Mode

DEVM (dB), VDD = 3.3V
RFX8055 802.11n Dynamic EVM MCS7 HT20 vs. Output Power, VDD = 3.3V, over Frequency, 100 us Pulse, 50% Duty Cycle, 400nsec delay, Low Current Transmit Mode

DEVM (dB) , VDD = 3.3V

![Graph of EVM vs. Pout Burst for different frequencies (5.18 GHz, 5.32 GHz, 5.5 GHz, 5.58 GHz, 5.7 GHz, 5.805 GHz, and 5.825 GHz) with a -30dB line.]
RFX8055 802.11g Dynamic EVM 64 QAM vs. Output Power, VDD = 3.3V, over Frequency, 100 us Pulse, 50% Duty Cycle, 400nsec delay, Low Current Transmit Mode

DEVM (dB) , VDD = 3.3V
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